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ABSTRACT

A study investigated the relationships among vocabulary size, depth of vocabulary knowledge, and reading comprehension in English as a second language (ESL). Subjects were 74 native Chinese- and Korean-speaking students in intensive academic ESL courses in two Ontario universities. They were administered questionnaires to gather demographic and language background information, and four English language tests: vocabulary size; reading comprehension; depth of vocabulary knowledge; and morphological knowledge. Results support the hypotheses that scores on ESL vocabulary size, depth of vocabulary knowledge, and reading comprehension would correlate highly with each other, and that for learners with an English vocabulary size of over 3,000, scores on depth of vocabulary knowledge would make a significant and unique contribution to prediction of reading comprehension. Implications for second language education are considered. (Contains 30 references.) (MSE)

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THE VALUE OF VOCABULARY KNOWLEDGE MEASURES IN PREDICTING ESL READING COMPREHENSION

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INTRODUCTION

Breadth and Depth of Vocabulary Knowledge

Recent second language (L2) research has considered breadth and depth two primary dimensions of vocabulary knowledge (eg., Henriksen, in press; Qian, 1998; Schmitt & McCarthy, 1997; Wesche & Paribakht, 1996.). Breadth of vocabulary knowledge is normally regarded as vocabulary size, or the number of words for which a learner has at least some minimum knowledge of meaning. Depth of vocabulary knowledge is generally defined as the learner's level of knowledge of various aspects of a given word.

Over the years, researchers such as Cronbach (1942), Dale (1965), Nation (1990) and Richards (1976) have proposed generally complimentary conceptual frameworks of vocabulary knowledge. These frameworks can be categorized into three types. The first is component-focused (e.g., Richards, 1976), the second is based on the learner's level of familiarity with a given word (e.g., Dale, 1965), and the third is a combination of the above two (e.g., Cronbach, 1942; Nation, 1990). However, produced in different contexts, these frameworks do not provide an explicit description of what compose the mass of vocabulary knowledge in the context of distinguishing depth from breadth. In order to provide a theoretical framework for the present study, a working definition of depth of vocabulary knowledge is proposed below (see also Qian, 1999a). This framework takes into account the merits of previous frameworks, particularly the definitions by Richards (1976) and Nation (1990). The framework identifies various important aspects composing depth of vocabulary knowledge for reading, especially from the perspective of their possible contribution to reading comprehension processes.

1. Pronunciation and spelling: This involves knowing how different forms of the word are pronounced and spelled;
2. Morphological properties: This involves knowing the word's stem, its capability of inflection, derivation, and other word formation devices, and its possible parts of speech;
3. Syntactic properties: this involves knowing the word's possible positions and its syntagmatic relations, including collocational relations, with other words in a sentence;
4. Meaning: This not only involves identification of the denotative meaning of a word in context, but also, where applicable, knowledge of connotations, as well as polysemy, antonymy, synonymy and other paradigmatic relations the word may have;
5. Register, or discourse features: These include possible adherence to a stylistic, social or regional variety, and the field, mode and manner of discourse concerning the application of the word;
6. Frequency of the word in the language, or whether this word is a commonly used word or a rarely used word only appearing in some specialized texts.

It has been argued that breadth and depth are interconnected dimensions of vocabulary knowledge, the development of which are interdependent to a substantial extent (Qian, 1998; 1999a). With the exception of adults who are particularly knowledgeable in a certain domain, due to experience or specialized training, it would be rare for an L2 reader to have superior and in-depth knowledge of vocabulary in a given language when his or her overall size of vocabulary in that language was very limited. By the same token, a large vocabulary would probably not take a reader very far if his or her knowledge of this vocabulary was shallow and superficial. Therefore, while vocabulary size matters a great deal in assessing the relationship between vocabulary knowledge and reading comprehension, the integral place of depth of vocabulary knowledge in this relationship should also be accorded equal recognition.

Threshold Vocabulary for Reading Comprehension

The threshold hypothesis in reading comprehension (Clarke, 1979, 1980; Cummins, 1979; Laufer, 1989, 1992, 1996; Nation, 1990) postulates that, in terms of vocabulary size, there is a threshold level below which the reader will be handicapped by a lack of comprehension and above which the reader will be able to apply his or her reading strategies to help comprehension and achieve better results. Findings from Laufer's (1989, 1992, 1996) studies, in which general academic texts in English were used to measure comprehension, support this hypothesis. Laufer pointed out that a threshold of 95% lexical coverage of a text is needed for comprehension and is critical in distinguishing a relatively proficient reader (with a minimum of 56% text comprehension in Laufer's studies) from a non-reader. This 95% lexical coverage translates into around 3,000 word families, or about 5,000 individual word forms (Laufer, 1996; Nation, 1993).

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Previous Research on the Relationship between Vocabulary and Reading in L2

A few studies (e.g., Koda, 1989; Laufer, 1992, 1996) have used scores on vocabulary measures in L2 to predict levels of academic reading comprehension. Laufer (1996) found "good and significant correlations" (p. 55) between the vocabulary size tests and reading comprehension tests. Koda's (1989) study of 24 college students learning Japanese as a foreign language found equally strong correlations between a self-made vocabulary test and two reading tests, one being a cloze and the other paragraph comprehension with short-answer questions. Koda reported a correlation of .69 between the learners' scores on the vocabulary test and the cloze, and a correlation of .74 between their scores on the vocabulary test and the paragraph comprehension test. These reports indicate that there is a high correlation between the learner's breadth of vocabulary knowledge and their reading comprehension levels, and that scores on vocabulary size are capable of predicting performance on reading tasks.

THE PRESENT STUDY

This paper reports on an empirical investigation designed to assess relationships among vocabulary size, depth of vocabulary knowledge, and reading comprehension in English as a second language (ESL).

Hypothesis One

In ESL, scores on vocabulary size, depth of vocabulary knowledge and reading comprehension will correlate highly with one another at a minimum level of $r = .50$ ($p < .05$).

Hypothesis Two

For ESL learners whose vocabulary size is beyond the 3,000 word-family threshold level for reading comprehension, scores on depth of vocabulary knowledge will make a significant, and unique, contribution to the prediction of reading comprehension scores, over and above the prediction afforded by vocabulary size sccres.

Participants

The participants were all students attending intensive academic ESL programs in two major universities in Ontario. Three criteria were used to recruit the participants. First, in line with Hypothesis 2, this study was aimed at an ESL population whose L2 vocabulary size was at the 3,000 word-family level or better. Second, to minimize the influence of L1 on their ESL performance, the L1 background of the participants needed be languages that are not cognate with English. For this reason, Chinese and Korean ESL learners were sought as target groups. The third criterion stipulated that the educational levels of the participants should be within the range from the completion of high school at the lower end, to the completion of university undergraduate studies in their home countries at the higher end. At these levels, learners should be able to handle general academic texts, which composed an important part of the instruments for this study. Altogether, 74 participants were included in this research. There was a total of 41 Korean speakers, 5 male and 36 female, and a total of 33 Chinese speakers, 5 male and 28 female. Their average age was 25.3, and the average duration of their stay in Canada was 3.6 months.

Instruments

Background questionnaire. This questionnaire was designed to obtain information on participants' age, educational level, academic field, L1, length of learning English, and duration of stay in Canada.

Vocabulary size test. Originally called the *Vocabulary Levels Test* (Nation, 1983), this English vocabulary size test (VS) has been accepted by a number of L2 researchers as an appropriate measure of vocabulary size (cf. Laufer, 1992, 1996; Yu, 1996). The test is composed of five parts representing five different vocabulary size levels, namely, the 2,000 word-family level, the 3,000 word-family level, the 5,000 word-family level, the university word list level, and the 10,000 word-family level. At each vocabulary size level, there are six test items, each comprising six words and three definitions. The test-taker is required to match the three definitions with three of the six words provided by writing the corresponding number of the word beside its definition. Each level contains 18 correct choices. The 2,000 and 3,000 word-family levels of the VS include high frequency words in English; the 5,000 word-family level is a boundary level between the high frequency level and low frequency level; and the 10,000 word-family level is composed of low frequency words. The university word list level contains specialized vocabulary needed for academic studies. The vocabulary items selected for the university word list level represent words frequently appearing in university textbooks. The list is mainly based on *An Academic Vocabulary List* (Campion and Elley, 1971) compiled for non-native English speakers attending universities in English-speaking countries. An example is provided below.

1	ceiling	
2	office	3 something that tells time
3	watch	5 main body of a tree
4	vehicle	6 a tool used for writing
5	trunk	
6	pen	

Reading comprehension test. This test was a standardized multiple-choice reading comprehension test (hereafter RC), taken

from a form of TOEFL (Educational Testing Service, 1987). Because of the anticipated time constraints on administering the tests, there was a need to shorten the test. As a result, two passages were randomly removed along with the comprehension questions attached to them. The resultant test had four reading passages with 20 multiple-choice questions to measure reading comprehension levels.

Depth-of-vocabulary-knowledge test. Originally called the *Word Associates Format* (Read, 1989, 1993, 1994, 1995), this depth-of-vocabulary-knowledge test (hereafter DVK) assesses some aspects of vocabulary depth in English. A recent version of the DVK, made available for the present study, is composed of 40 items designed to measure two aspects of the depth of vocabulary knowledge: meaning and collocation. The aspects that the DVK measures match some important components of depth of vocabulary knowledge proposed in the present study, such as meaning and collocation.

Each DVK item consists of one stimulus adjective and two boxes, each containing four words. Among the four words in the left box, one to three words can be synonymous to one aspect of, or the whole, meaning of the stimulus word, while among the four words in the right box there can be one to three words that collocate with the stimulus word. Each item always has four correct choices. However, these choices are not evenly spread. There are three possible situations: (1) the left and right boxes both contain two correct answers; (2) the left box contains one correct choice, while the right box contains three correct answers; and (3) the left box contains three correct answers, while the right box contains only one correct choice. This arrangement effectively reduces the chances of guessing. An example is provided below.

sound

logical healthy bold solid	snow temperature sleep dance

Most of the stimulus adjectives were selected from *Barnard's Second and Third Thousand Word Lists* (Nation, 1986), which include a large number of high frequency academic words. The DVK went through repeated piloting and refining (Read, 1994, 1995). In one trial (N = 94), a high correlation (r = .82) was found between the DVK and a comparison vocabulary matching test. The IRT-based Rasch reliability of the DVK in this trial was .93, and that of the matching test was .90 (Read, 1995). In another trial (N = 38), a correlation coefficient of .85 (p < .01) was reported (Read, 1994) between the DVK and the matching test.

Morphological knowledge test. A measure made for the present study, *The Morphological Knowledge Test* (hereafter MK) was designed to measure morphological aspects of vocabulary knowledge. The MK has 10 stimulus words shared by the two parts of the test. One part, which contains 10 items, measures knowledge of lexical affixes and stems. All 10 stimulus words of the affix subtest contain a prefix or a suffix. The test requires the test-taker to define, in English or the person's L1, the 10 stimulus words, including the affixes. The other part measures knowledge of parts of speech. In this part-of-speech subtest, the stimulus words appear in two forms, the stem and the stem plus an affix. This part requires the test-taker to identify the correct parts of speech of the two forms of a given word. The 10 stimulus words of the MK were all selected from the reading passages in the RC. An example follows:

> Instructions: Explain the meaning of the following 10 words in English, or translate them into your first language. If the underlined part of the word has changed the part of speech of the base word, please indicate this by using appropriate terms provided below.
>
> Possible terms: *noun, verb, adjective, adverb, preposition*
>
Example: Word	Meaning or translation of the word	The change in the part of speech caused by the underlined part
homeless	*without home*	*n.* → *adj.*

Procedures, Analyses and Results

All the above instruments were administered to participants in single sessions. The purposes of the data analysis were to find out: (1) the intercorrelations among vocabulary size, depth of vocabulary knowledge, and reading comprehension, and (2) the extent to which scores on depth of vocabulary knowledge would improve the prediction of reading comprehension levels already provided by vocabulary size scores. One-tailed Pearson product-moment correlations and multiple regression were chosen as the dominant techniques for the statistical analyses. Correlations were computed for scores from the RC, VS, DVK, and MK to determine the intercorrelations among the four tests. In the regression analysis, the scores on the RC were used as the dependent variable and those on the VS, DVK, and MK as the independent variables. The following results were obtained from the data analysis.

Intercorrelations. Table 1 reports the results of the one-tailed product-moment correlation analyses. The coefficients in the table indicate high intercorrelations among the scores on the RC, VS, DVK, and MK.

Table 1. Pearson correlations among scores on the RC, VS, DVK, and MK (N=74)

Variable	RC	VS	DVK
VS	.78*		
DVK	.82*	.82*	
MK	.64*	.69*	.63*

* Significant at .05.
VS = Score on the Vocabulary Size Test.
DVK = Score on the Depth-of-Vocabulary-Knowledge Test.
MK = Score on the Morphological Knowledge Test.

Multiple regression. In the multiple regression analysis, the forced entry procedure was used in order to manually determine the order of entry of variables into the regression equation, so that the order would conform to the operational framework specified earlier. The analysis focused on examining the changes in the magnitude of the R^2, or the variance in the dependent variable that was accounted for by the independent variables (Smith and Glass, 1987). This was achieved by observing the size of the portion of R^2 that was added by the scores on the DVK, as well as by the scores on the DVK and MK jointly, to cover the dimension of depth of vocabulary knowledge when the scores on the VS were already in the equation. The stepwise procedure was used to remove from the equation any independent variables that did not qualify as predictors of the dependent variable RC. The procedures and R^2 changes are summarized in Table 2 below.

Table 2. Multiple regression results with scores on the VS, DVK, and MK as the independent variables (N=74).

Step	Procedure	Variable	Status	R^2	R^2 change
1	forced entry	VS	in	.60*	
2	forced entry	DVK	in	.71*	.11*
3	forced entry	MK	in	.72*	.01
4	stepwise	MK	out	.71*	-.01

* Significant at .05.

As the above results indicate, among the three predictor variables, DVK added a unique portion (11%) of explained variance in RC on top of the 60% variance accounted for by VS. In contrast, MKs contribution of 1% additional explained variance in RC was negligible.

As an additional procedure, a fresh model was built to determine (a) the predictive power of DVK in forecasting RC scores when DVK was entered into the equation first, and (b) the size of prediction of RC added by VS over and above the prediction already afforded by DVK. The results showed that the R^2 was .68 ($F = 152.17$, $p < .05$) when DVK alone was in the equation. After VS was added to the equation, the R^2 increased by 0.03 to 0.71 (F change = 8.03, $p < .05$). That is, VS added 3% explained variance in RC on top of the prediction already provided by DVK.

DISCUSSION AND IMPLICATIONS

The Pearson correlation coefficients obtained for the variable pairs of RC, VS, DVK, and MK were all higher than .60 ($p < .05$). In other words, high and positive intercorrelations existed among the scores on the four tests. This finding supports Hypothesis 1. In fact, the correlations among DVK, VS, and RC were especially high, which indicates that, for this given sample and among the four tests under discussion, the scores on the DVK, which represented the meaning and collocation components of depth of vocabulary knowledge, were highly correlated with learners' reading comprehension scores, and therefore should be very closely associated with the test-takers' general academic reading comprehension levels. On the other hand, the high correlation between the scores on the DVK and VS strongly suggests that learners' scores on the depth and breadth dimensions of the vocabulary knowledge are also closely, and positively, associated, which leads us to believe that development of the two dimensions are probably indeed interconnected and interdependent. In the multiple regression analysis, the results showed that both VS and DVK contributed significantly to the prediction of RC, and that DVK added a noticeable 11% of explained variance in RC over and above the prediction already afforded by VS. In other words, DVK, which represented scores on two components of depth of vocabulary knowledge (lexical meaning and collocation), made a significant, and unique, contribution to the prediction of scores on academic

reading comprehension beyond the prediction provided by scores on vocabulary size. In comparison, the results of the additional analysis showed that, although it contributed significantly to the prediction of RC, VS added only 3% explained variance in RC over and above the prediction already provided by DVK.

Meanwhile, the results also indicated that MK, representing some morphological sub-components of depth of vocabulary knowledge, was not capable of predicting RC, because of the negligible magnitude MK added to the explained variance in RC during the regression model building process, and also because MK was eliminated from the regression model by the stepwise procedure. This incapability of MK to predict RC may be due to the possibility that the MK failed to measure what it was designed to measure, or that one's morphological knowledge is simply not indicative of reading comprehension levels, although in the present study scores on morphological knowledge and reading comprehension were indeed fairly highly correlated. Nevertheless, these findings still suggest that some aspects of depth of vocabulary knowledge have a fundamental role to play in the relationship of vocabulary knowledge and reading comprehension because the present study has confirmed the DVK's capability of making significant and unique prediction of reading comprehension scores.

The present study has shown with empirical evidence that depth of vocabulary knowledge is an important factor in the relationship between vocabulary knowledge and reading comprehension[1]. Meanwhile, the study has also confirmed the important role of breadth of vocabulary knowledge in this relationship. The findings from the present study have implications for both research and L2 education.

Implications for L2 Education

As the present research showed, vocabulary knowledge should no longer be regarded as a simple matter of recognizing word meaning. Vocabulary knowledge not only has breadth, as represented by the number of words known to a learner, but also has depth. The working definition of depth of vocabulary knowledge established in the present study involves a number of aspects representing various types of linguistic knowledge. The importance of depth of vocabulary knowledge in reading comprehension has been established in the present research based on empirical evidence. Now it is up to educators -- curriculum designers and ESL teachers -- to incorporate this factor into their ESL syllabi and activities. It would also be highly desirable to communicate this importance to ESL learners so that they will be aware of the benefit of paying attention to aspects of vocabulary knowledge beyond superficial meaning recognition while learning English words, and learn to be able to do so effectively.

Vocabulary Measures as Predictors of Other Language Skill Levels

The present research investigated the value of vocabulary knowledge tests in assessing reading comprehension levels. The research did not touch upon using scores on vocabulary knowledge tests to predict proficiency for other language skills. Since "vocabulary knowledge is heavily implicated in all practical language skills" (Meara & Jones, 1988, p. 80), learners with a superior vocabulary knowledge should perform better in other language aspects than learners with limited vocabulary knowledge. This theoretical assumption is worth testing. Future studies should determine whether vocabulary knowledge tests can predict proficiency of other language skills, such as listening and writing. Laufer and Nation (1995) made a meaningful start in this direction. Their investigation found that, for intermediate ESL learners, there is a close relationship between vocabulary size and lexical richness in writing.

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[1] A follow-up study (Qian, 1998, 1999b) was carried out to explore the reading comprehension processes of a sub-sample. The study was a qualitative investigation mainly based on individual retrospective and introspective interviews focusing on how the learners made use of their various knowledge sources, especially their depths of vocabulary knowledge, in processing lexical meanings of unknown or unfamiliar words in the comprehension processes. The results confirmed that depth of vocabulary knowledge was the main knowledge source the participating learners used in inferring meanings of unknown words.

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